

SECRET

31 May 1963

MEMORANDUM FOR: Assistant for Plans and Development

THROUGH: Executive Secretary, TDC

SUBJECT: Staff Study - [REDACTED] Proposal for
Development of a Prototype Coherent
Light Enlarger and Spatial Filter

REFERENCE: (a) [REDACTED] of 24 April 1963,
entitled "Proposal for Prototype Coherent Light
Enlarger and Spatial Filter."

25X1

25X1

1. PROBLEM:

To develop an image modulation transfer system by which the photo interpreter can fully exploit intelligence information contained in original low contrast imagery recorded at frequencies as high as 200 cyc/mm.

2. FACTS:

Aerial photographic acquisition equipment, techniques and materials are now capable of producing original negatives containing intelligence information at spatial frequencies up to 200 cyc/mm. Due to physical image attenuations introduced by the atmosphere, vibrations and other elements of the photographic system, such high resolution imagery is invariably of low amplitude modulation (contrast). This order of resolution at low contrast exceeds the modulation transfer capability of all current systems and can be read-out only by use of a high performance laboratory microscope. Frequent substitution of the laboratory microscope for commonly used low-power magnifiers and viewers for large volume interpretation is not practical. This is due primarily to the miniscule field of view, for a suitable objective. Such a narrow field would limit the interpreter's view of the subject and very seriously retard the process of image analysis at a time when the need for acceleration of interpretation procedures has become imperative.

SECRET

-2-

3. DISCUSSION:

a. If, in a conventional approach to the problem, one were to assume development of the (diffraction-limited) lens to achieve a modulation transfer function of 0.9 at 200 cyc/mm, it could be shown mathematically that the image cone of light must be faster than $f/1$. To achieve a modulation transfer function of 1.0 at 4X enlargement would require a lens faster than $f/0.8$. Such a lens would be practically impossible to design as a diffraction-limited system to cover a 70mm square format.

b. It therefore becomes apparent that the problem cannot be overcome by conventional optics. In recognition of this fact and anticipation of acquisition frequencies far in excess of those previously encountered, [] has submitted the subject proposal embodying a new and proprietary concept by which this deficiency can be alleviated.

25X1

c. The proposed method would include development of a fixed 4X coherent light enlarger and spatial filter. The concept of coherent illumination is said to yield benefits in the modulation transfer function achievable with relatively slow lenses. The theoretically achievable modulation transfer function with an $f/4$ lens at 200 cyc/mm remains at unity out to one-half the limiting frequency for incoherent illumination and then drops to zero. With coherent illumination, an $f/4$ cone of light is therefore expected to yield 100% modulation transfer function at 200 cyc/mm.

d. In practical application the proposed enlarging system at 4X magnification can be expected to produce a transparency in which the modulation spatial frequency has been reduced to one-fourth, while the amplitude modulation remains at unity. Stated in other terms, information contained in the 200 cyc/mm recording in the original transparency is presented at 50 cyc/mm while the amplitude modulation (contrast) of the image remains identical to that of the original. Without loss of information the P.I. would then be able to read out the image fully with conventional viewing instruments.

e. [] has proposed first to produce a breadboard unit and then a deliverable prototype coherent light enlarger. It is intended that the breadboard unit will serve to prove out the principles and provide a base for making final design decisions and measurements. The prototype will then be fabricated on the basis of the findings. All usable parts and components of the breadboard unit will be incorporated in the prototype.

25X1

SECRET

-3-

f. [] proposes to use a He He gas phase continuous laser operating at 6328 angstroms. This is a red emitting source that does not coincide with the blue spectral sensitivity of currently used high resolution print materials. Since the print film is to be GF2 and because of the importance of correspondence between the illuminant color and film sensitivity, a letter supplement to the proposal should be obtained from the contractor, specifying the film type required for the system, prior to contract award.

25X1

g. The total proposed contract price amounts to [] By letter of 1 May 1963 [] submitted a revised cost breakdown that separated the breadboard cost, in the amount [] from the total contract price. By telephone communication with [] on 14 May, it was learned that the company is prepared to commence work immediately upon notification to do so. The Administrative Staff has advised that sufficient FY-63 funds are available to support the program through the breadboard stage.

25X1

25X1

25X1

25X1

h. Delivery of the prototype enlarger is scheduled 13 months from date of contract award.

4. CONCLUSIONS:

a. The inability to readout low contrast imagery at 200 cyc/mm with existing equipment is well-recognized and must be dealt with promptly if full advantage is to be taken of forthcoming significant improvements in fidelity of acquisition systems.

b. The deficiency in readout methods and equipment cannot be overcome by conventional optics.

c. The laser coherent light enlarger approach proposed by the [] appears basically sound and should be pursued without delay.

25X1

25X1

5. RECOMMENDATIONS:

a. The [] proposal be accepted and that a contract be negotiated on a CPFF basis at a total cost of [] with the proviso that the proposed contractor specify the film type required prior to award.

25X1

25X1

b. The contract be funded immediately in the amount of [] from FY-63 funds to cover the breadboard phase of the program.

25X1

[]
Development Branch, R&DS

25X1

SECRET

RECOMMENDATION SHEET

Development of a Prototype Coherent Light Enlarger and Spatial Filter

25X1

APPROVED:

Executive Director/ HPIC

7 June 1963
/Date

25X1

SECRET